

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Priority Application Serial No. .... 09/714,714  
Priority Filing Date ..... November 15, 2000  
Inventor ..... Kardokus, J. et al  
Assignee ..... Honeywell International, Inc  
Priority Group Art Unit ..... 1742  
Priority Examiner ..... Ip, S  
Attorney's Docket No. .... JM34006 DIV  
Title: (As Amended) Methods of Forming Copper-Containing Sputtering Targets

**PRELIMINARY AMENDMENT**

To: Box Patent Application  
Assistant Commissioner for Patents  
Washington, D.C. 20231

From: Jennifer J. Taylor, Ph.D. (Tel. 509-624-4276; Fax 509-838-3424)  
Wells, St. John, Roberts, Gregory & Matkin P.S.  
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Spokane, WA 99201-3828

**AMENDMENTS**

**In the Specification**

Please replace the Title with the following new Title:

--Methods of Forming Copper --Containing Sputtering Targets--

Before the "Background of the Invention" section, please add:

--RELATED PATENT DATA

This patent resulted from a divisional application of U.S. Patent Application Serial No. 09/714,714; which is a continuation application of U.S. Patent Application Serial No.

09/615,474, filed on July 13, 2000; which is a continuation application of U.S. Patent Application Serial No. 09/324,299, filed on June 2, 1999, and now U.S. Patent 6,113,761.--

Please replace the paragraph beginning at line 32 of page 4 with the following clean replacement paragraphs in accordance with 37 C.F.R. § 1.121(b)(1)(ii):

--FIG. 10 is a photomicrograph of a Cu target, CuCr intermediate layer and an Al backing plate;

FIG. 11 is a photomicrograph of a Cu target, CuCr intermediate layer and an Al backing plate; and--.

Please replace the paragraph starting at line 6 on page 19 with the following clean replacement paragraph:

--The invention includes a method of forming a sputtering target containing copper of a purity of at least about 99.999 wt.%, and at least one component selected from the group consisting of Ag, Sn, Te, In, B, Bi, Sb, and P dispersed within the copper. The total of Ag, Sn, Te, In, B, Bi, Sb, and P within the copper is from at least 0.3 ppm to about 10 ppm. The sputtering target has a substantially uniform grain size of less than or equal to about 50 micrometers throughout the copper and the at least one component.--

### **In The Claims**

Please cancel claims 1-9 and 14-17. Please add new claims 18-22.

A marked up version showing amendments to any claims being changed is provided in one or more accompanying pages separate from this amendment in accordance with 37 C.F.R. § 1.121(c)(1)(ii). Any claim not accompanied by a marked up version has not been

changed relative to the immediate prior version, except that marked up versions are not being supplied for any canceled claim.

10. (Amended) A method of making a sputtering target assembly comprising:

a) providing high purity copper target of at least about 99.999 wt.% purity;

b) preparing a master alloy comprising copper and not more than about 10 ppm of at least one of Ag, Sn, Te, In, Mg, B, Bi, Sb, and P;

c) preparing a cast billet by forming a molten combination of copper and master alloy and solidifying the molten combination;

d) deforming the cast billet for a total of at least about 50% deformation on each axis and then rapidly quenching the deformed billet;

e) frictionless forging the quenched billet at elevated temperature to about 70% of the starting length of the billet, and rapidly quenching;

f) cold rolling to a total of about 90% deformation;

g) providing an aluminum alloy backing plate having a preclad CuCr surface; and precipitation hardening the aluminum alloy backing plate.

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11. (Amended) A method according to claim 10 wherein the preparing said master alloy comprises:

forming a combination by combining the high purity copper with the at least one of Ag, Sn, Ti, In, Mg, B, Bi, Sb, and P;  
melting the combination; and  
casting the combination.

12. (Amended) A method according to claim 11 wherein the high purity copper is combined with the at least one of Ag, Sn, Ti, In, Mg, B, Bi, Sb, and P in a ratio of about 1000 to 1.

13. (Amended) A method according to claim 10 further comprising:

forming the aluminum alloy backing plate wherein the forming comprises:

embedding an alloy of Cu and Cr in an aluminum or aluminum alloy envelope;

welding the envelope closed in a vacuum environment;

heat treating the enclosed envelope;

forging, wherein the forging brings the CuCr into intimate contact with the aluminum alloy to be used as a backing plate;

quenching;

removing the aluminum alloy envelope to expose the CuCr surface; and

precipitation hardening the aluminum alloy.

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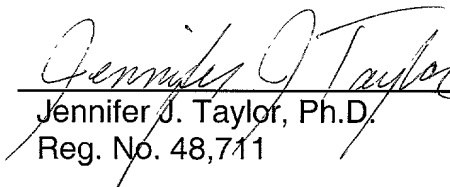
18. A method of forming a sputtering target comprising:
- forming a master alloy comprising:
    - a first high purity copper material; and
    - a micro-alloy grain stabilizer comprising at least one of Ag, Sn, Te, In, Mg, B, Bi, Sb, and P dispersed within the first high purity copper material;
  - adding an amount of the master alloy to a second high purity copper material to form a sputtering target composition having a desired concentration of the micro-alloy grain stabilizer dispersed within copper; and
  - shaping the sputtering target composition into a target configuration.
19. The method of claim 18 wherein the forming the master alloy comprises combining the first high purity copper material with the micro-alloy grain stabilizer in a ratio of at least about 1000 parts copper to 1 part of the micro-alloy grain stabilizer.
20. The method of claim 18 wherein the first and second high purity copper materials have a purities of at least about 99.999 wt.%.
21. The method of claim 18 wherein the first and second high purity copper materials have a purities of at least about 99.9995 wt.%.
22. The method of claim 18 wherein the micro-alloy grain stabilizer is silver.

**REMARKS**

Claims 1-9 and 14-17 are cancelled. Claims 10-13 are amended. New claims 18-22 are added. Claims 10-13 and 18-22 are pending in the application. Applicant respectfully requests examination of the pending claims.

Respectfully submitted,

Dated: Dec. 19, 2001 By:

  
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Reg. No. 48,711

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**MARKED UP VERSION OF AMENDMENTS ACCOMPANYING PRELIMINARY**

**AMENDMENT**

**In the Specification**

The replacement specification paragraphs incorporate the following amendments.

Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

The Title has been amended as follows:

~~Copper Sputtering Targets and Method of Making Same~~ Methods of Forming  
Copper-Containing Sputtering Targets

The Related Patent Data section is added before the Background of the Invention  
section as follows:

**--RELATED PATENT DATA**

This patent resulted from a divisional application of U.S. Patent Application Serial  
No. 09/714,714; which is a continuation application of U.S. Patent Application Serial No.  
09/615,474, filed on July 13, 2000; which is a continuation application of U.S. Patent  
Application Serial No. 09/324,299, filed on June 2, 1999, and now U.S. Patent 6,113,761.--

The paragraph beginning at line 32 on page 4 has been amended as follows:

~~FIGS. 10 and 11 are photomicrographs of a Cu target, CuCr intermediate layer and an Al backing plate; and FIG. 10 is a photomicrograph of a Cu target, CuCr intermediate layer and an Al backing plate;~~

FIG. 11 is a photomicrograph of a Cu target, CuCr intermediate layer and an Al backing plate; and

The paragraph beginning at line 6 on page 19 has been amended as follows:

~~Described is a sputtering target assembly of high purity copper diffusion bonded to a precipitation hardened aluminum alloy backing plate via an intermediate layer of a CuCr alloy and in which the copper contains a micro alloy addition of at least one of Ag, Sn, Te, In, Mg, B, Bi, Sb and/or P. Also disclosed is a method that includes preparation of a master alloy for addition to high purity copper and fabricating, heat treating and diffusion bonding processes to produce a sputtering target assembly with a stable fine-grained target microstructure. The invention includes a method of forming a sputtering target containing copper of a purity of at least about 99.999 wt.%, and at least one component selected from the group consisting of Ag, Sn, Te, In, B, Bi, Sb, and P dispersed within the copper. The total of Ag, Sn, Te, In, B, Bi, Sb, and P within the copper is from at least 0.3 ppm to about 10 ppm. The sputtering target has a substantially uniform grain size of less than or equal to about 50 micrometers throughout the copper and the at least one component.~~

The invention includes a method of forming a sputtering target containing copper of a purity of at least about 99.999 wt.%, and at least one component selected from the group consisting of Ag, Sn, Te, In, B, Bi, Sb, and P dispersed within the copper. The total of Ag, Sn, Te, In, B, Bi, Sb, and P within the copper is from at least 0.3 ppm to about 10 ppm. The sputtering target has a substantially uniform grain size of less than or equal to about 50 micrometers throughout the copper and the at least one component.

### **In the Claims**

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.



10. (Amended) A method of making a sputtering target assembly comprising:

a) providing high purity copper target of at least about 99.999 wt.% purity;

b) preparing a master alloy ~~of~~ comprising copper and not more than about 10 ppm of at least one of Ag, Sn, Te, In, Mg, B, Bi, Sb, and P;

c) preparing a cast billet by forming a molten combination of copper and master alloy and ~~solidify~~ solidifying the molten combination ~~to produce a cast billet~~;

d) ~~hot~~ deforming the cast billet for a total of at least about 50% deformation on each axis and then rapidly quenching the deformed billet, ~~preferably in water~~;

e) frictionless forging the quenched billet at elevated temperature to about 70% of the starting length of the billet, and rapidly quenching, ~~preferably in water~~;

f) cold rolling to a total of about 90% deformation;

g) providing an aluminum alloy backing plate having a preclad CuCr surface; and precipitation hardening the aluminum alloy backing plate ~~to the fully hard T6 condition~~.

11. (Amended) A method according to claim ~~9~~ 10 wherein the preparing said master alloy ~~is prepared by~~ comprises:

forming a combination by combining ~~a major amount of the~~ high purity copper with a ~~minor amount of the~~ at least one of Ag, Sn, Ti, In, Mg, B, Bi, Sb, and P;

melting the combination; and

casting the combination ~~to produce a master alloy~~.

12. (Amended) A method according to claim ~~10~~ 11 wherein the high purity copper is combined with the at least one of Ag, Sn, Ti, In, Mg, B, Bi, Sb, and ~~and/or~~ P in a ratio of about 1000 to 1.

13. (Amended) A method according to claim 9 10 further comprising:  
forming ~~wherein~~ the aluminum alloy backing plate wherein the forming comprises:  
~~having a precladding surface of CuCr diffusion bonded thereto is used which~~  
~~is produced by a process comprising~~ embedding an alloy of Cu and Cr in an  
aluminum or aluminum alloy envelope; ~~and e-beam~~  
welding the envelope closed in a vacuum environment;  
heat treating the enclosed envelope; ~~and~~  
forging, wherein the forging to bring brings the CuCr into intimate contact with  
the aluminum alloy to be used as a backing plate;  
quenching;  
removing the aluminum alloy envelope to expose the CuCr surface; and  
precipitation ~~hardening~~ hardening the aluminum alloy ~~to full hard T6 condition.~~

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18. A method of forming a sputtering target comprising:  
forming a master alloy comprising:  
a first high purity copper material; and  
a micro-alloy grain stabilizer comprising at least one of  
Ag, Sn, Te, In, Mg, B, Bi, Sb, and P dispersed within the first  
high purity copper material;  
adding an amount of the master alloy to a second high purity  
copper material to form a sputtering target composition having a  
desired concentration of the micro-alloy grain stabilizer dispersed  
within copper; and  
shaping the sputtering target composition into a target  
configuration.
19. The method of claim 18 wherein the forming the master alloy  
comprises combining the first high purity copper material with the micro-alloy  
grain stabilizer in a ratio of at least about 1000 parts copper to 1 part of the  
micro-alloy grain stabilizer.
20. The method of claim 18 wherein the first and second high purity  
copper materials have a purities of at least about 99.999 wt.%.
21. The method of claim 18 wherein the first and second high purity  
copper materials have a purities of at least about 99.9995 wt.%.
22. The method of claim 18 wherein the micro-alloy grain stabilizer is  
silver.

END OF DOCUMENT